

Risk-Aversion and the Bifurcated Interest Responses of Corporate Investment: Theory and Evidence

Ying Wu, Salisbury University, Salisbury, Maryland 21801, U.S.A.

Research Questions

- In a liquidity trap, is the real interest rate always negatively related to corporate investment so that the AD curve must be upward sloping?
- Does U.S. investment in the 2008-09 Great Recession and its aftermath respond to an interest-rate increase differently from responding to a rate decrease over time? What is the short-term vs. long-term pattern in this regard?

Bifurcated Interest Rate Responsiveness of Investment

$$i(r) = \bar{i} + b_k \times \left(\frac{\theta - r}{s(r) - r} \right)$$

$$i'(r) = b_k \times \left(\frac{\theta r^2 - 2r + \theta}{(r^2 - 1)^2} \right) > 0, \text{ if } \theta > 1 \text{ (zones C, D, E); or if } r < r_1(\theta) < 1 \text{ when } \theta \leq 1 \text{ (zone B)}$$

$$< 0, \text{ if } r_1(\theta) < r < 1 \text{ when } \theta \leq 1 \text{ (zone A)}$$

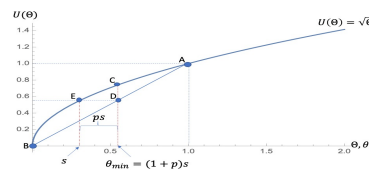


Figure 1 Safety Preference and Threshold for Risk Taking

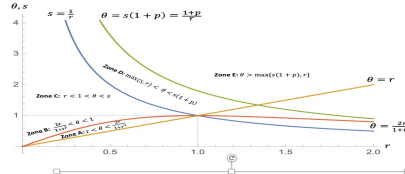


Figure 2 Corporate Investment Profile

The Kinked AD Curve in a Liquidity Trap

$$\text{The AD equation: } \begin{cases} Y = [C + c(Y - T)] + [I + b_k \times \left(\frac{\theta - r}{s(r) - r} \right)] + G \\ r = -\pi + f \end{cases}$$

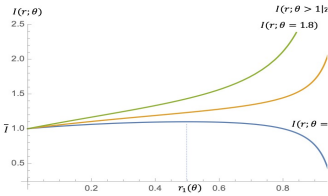


Figure 3 Aggregate Investment

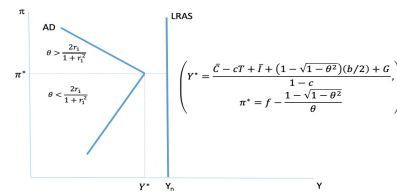


Figure 4 The Kinked Aggregate Demand (AD)

Comparing Laissez Faire with QE When AD is Downward Sloping

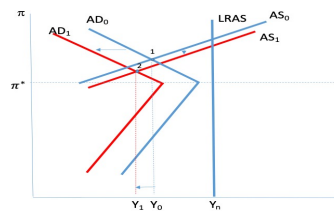


Figure 5 Ineffectiveness of QE

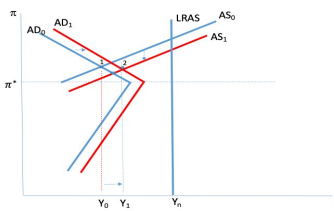


Figure 6 Effectiveness of Laissez Faire

In a Nutshell

- A leveraged risk-averse firm prefers a riskless return to risky investment project unless both the real interest rate and investment return are sufficiently high (Figs. 1 and 2), which generates a bifurcated aggregate investment schedule and a kinked AD curve (Figs. 3 and 4).
- Risk-averse corporate investment can be positively related to the interest rate and therefore the AD curve can still be downward sloping in a liquidity trap. Hence, while QE is ineffective, *laissez faire* can help increase investment through a disinflation process (Figs. 5 and 6).
- By estimating a NARDL model (Table 1) for the post-crisis era in the U.S., I find an asymmetric cointegration pattern in which investment **increases** with a **higher** interest rate **more** than its decrease with a lower interest rate in the long run, and an asymmetric adjustment pattern in which investment **decreases** with a **lower** interest rate **more** than its increase with a higher interest rate in the short run (Fig. 7).

Table 1 The Estimated Linear and Nonlinear ARDL Models for the Investment-Interest Rate Relation

Regressors	ARDL ECR Model (3, 3, 3, 0, 4)	D(RINV) (3, 2, 3, 2, 4, 3)	NARDL ECR Model (3, 2, 3, 2, 4, 3)
D(RINV _t)	0.474***		0.426***
D(RINV _{t-1})	0.269**		0.313***
D(RRATE _t)	54.136***		
D(RRATE _{t-1})	-29.06***		
D(RRATE_POS _t)	18.232*		
D(RRATE_POS _{t-1})		48.668***	
D(RRATE_NEG _t)		-55.241***	
D(RRATE_NEG _{t-1})		75.230***	
D(RRATE_NEG _t × FS _{t-1})		-22.555***	
D(RRATE_NEG _{t-1} × FS _{t-1})		23.835	
D(RINVRTN _t)	1.518		1.413
D(RINVRTN _{t-1})	2.630***		-1.804*
D(RINVRTN _t × FS _{t-1})	-0.416		-180.007***
D(FS _t)			-21.910
D(FS _{t-1})			27.837
D(FS _t × FS _{t-1})			11.927***
D(RRATE _t × FS _t)	22.397***		52.185***
D(RRATE _{t-1} × FS _{t-1})	2.628		7.492
D(RRATE _t × FS _{t-1})	1.105		-3.894
D(RRATE _{t-1} × FS _{t-1})	2.521***		
ADJ	21.59***		3.208***
CointEq ₁	-0.815***		-0.829***
F-Bound Test on cointegration (H ₀ : No cointegration)	F _{ARDL} =9.73>4.44 (upper bound at 1%)		F _{NARDL} =8.96>4.21 (upper bound at 1%)
t-Bound Test on cointegration (H ₀ : No cointegration)	t _{ARDL} [-6.44]>[-4.23] (upper bound at 1%)		t _{NARDL} [-8.19]>[-4.44] (upper bound at 1%)
Wald Test of Long-Run Symmetry			W _{LR} (χ ²) with p-value of 0.07
Wald Test of Short-Run Symmetry			W _{SR} (χ ²) with p-value of 0.06
R ²	0.835		0.881
Adjusted R ²	0.761		0.801

Co-integration Equation for ARDL Model

$$RINV_{t-1} + RRATE_{t-1} + 0.56 RINVRTN_{t-1} - 75.52FS_{t-1} + 11.18 RRATE_{t-1} \times FS_{t-1}$$

Co-integration Equation for NARDL Model

$$RINV_{t-1} + RRATE_{POS_{t-1}} + 37.01 RRATE_{NEG_{t-1}} - 0.40RINVRTN_{t-1} - 131.92FS_{t-1} + 29.08 RRATE_{t-1} \times FS_{t-1}$$

A Weekly Asymmetric Cumulative Positive Relation between Interest Rate and Investment beyond a Short Run

The asymmetry plot exhibits a net positive response of investment to interest rate shock after an investment stagnation (a severe liquidity trap) within a period of about a year.

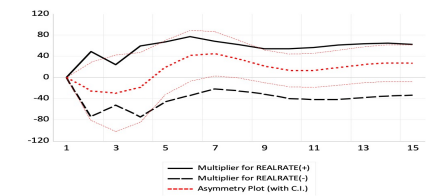


Figure 7 Asymmetric Cumulative Dynamic Multiplier

The CUSUM and CUSUMQ tests support the stability of estimated parameters and residual variance.

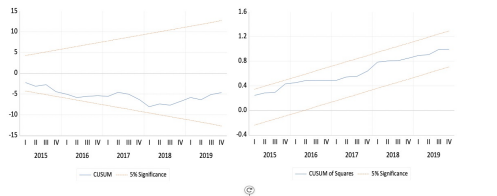


Figure 8 Stability of Parameters and Residual Variance

Conclusions

- The evolution of a liquidity trap can be analytically dichotomized into two regimes that generate the bifurcated investment response to interest rates and kinked aggregate demand curve:
 - A phase of severe recession with extremely low real interest rate and investment return
 - Risk averse firms prefer financial investment (saving) to capital investment
 - QE helps stimulate investment by lowering financial friction and raising inflation expectation
 - A phase of mild recession and its aftermath with higher real interest rates and investment return,
 - Investment activities increase
 - QE tends to negate the market forces that favor investment to corporate saving
- Empirically, I identify the dynamic process of regime switching by the nonlinearity of accumulative investment response to an increase vs. a decrease in the real interest rate.
 - In the short run, investment decreases with a lower interest rate more than increases with a higher interest rate.
 - In the long run, investment increases with a higher interest rate more than decreases with a lower interest rate.
 - The regime switching from a severe to mild recession occurred within a year after a real interest rate shock.
- The asymmetry results well echo my theoretical prediction of a positive relation between investment and the interest rate in a liquidity trap.
- The policy implication of this study supports a timely exit from QE and necessary increases in the policy interest rate in due course.